

CLAIMS

1. An isolated nucleic acid sequence or fragment thereof comprising or complementary to a nucleic acid sequence encoding a polypeptide, wherein the amino acid
5 sequence of said polypeptide has at least 65% amino acid sequence identity to an amino acid sequence comprising SEQ ID NO:10.

2. An isolated nucleic sequence or fragment
10 thereof comprising or complementary to a nucleic acid sequence having at least 70% nucleotide sequence identity to a nucleic acid sequence comprising SEQ ID NO:8.

3. An isolated nucleic acid sequence or fragment
15 thereof comprising or complementary to a nucleic acid sequence encoding a polypeptide, wherein the amino acid sequence of said polypeptide has at least 65% amino acid sequence identity to an amino acid sequence comprising
SEQ ID NO:11.

20 4. An isolated nucleic sequence or fragment thereof comprising or complementary to a nucleic acid sequence having at least 70% nucleotide sequence identity to a nucleic acid sequence comprising SEQ ID NO:9.

25 5. The isolated nucleic acid sequence of claim 1, claim 2, claim 3 or claim 4 wherein said sequence encodes a functionally active polyketide synthase enzyme.

30 6. The isolated nucleic acid sequence of claim 5, wherein said polyketide synthase enzyme modulates the production of at least one polyunsaturated fatty acid when expressed in a host cell.

7. The isolated nucleic acid sequence of claim 6, wherein said at least one polyunsaturated fatty acid is selected from the group consisting of eicosapentaenoic acid and docosahexaenoic acid.

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8. The isolated nucleic acid sequence of claim 1 or claim 3 wherein said sequence is isolated from *Thraustochytrium sp.*

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9. The isolated nucleic acid sequence of claim 2 or claim 4 wherein said sequence is isolated from *Thraustochytrium aureum*.

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10. A purified protein encoded by said nucleic acid sequence of claim 1 or claim 3.

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11. A purified protein or fragment thereof comprising an amino acid sequence having at least 65% amino acid sequence identity to an amino acid sequence comprising SEQ ID NO:10 or SEQ ID NO:11.

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12. A method of producing polyketide synthase enzymes comprising the steps of:

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- a) isolating a nucleic acid sequence comprising SEQ ID NO:8 or SEQ ID NO:9;
- b) constructing a vector comprising said isolated nucleic acid sequence operably linked to a regulatory sequence;
- c) introducing said vector into a host cell under time and conditions sufficient for expression of said polyketide synthase enzymes.

13. The method of claim 12 wherein said host cell

is selected from the group consisting of a eukaryotic cell and a prokaryotic cell.

14. A vector comprising a nucleic sequence
5 comprising SEQ ID NO:8 or SEQ ID NO:9, operably linked to a regulatory sequence.

15. A host cell comprising said vector of claim 14.

- 10 16. The host cell of claim 15 wherein said host cell is selected from the group consisting of a eukaryotic cell and a prokaryotic cell.

17. A plant cell, plant or plant tissue comprising
15 said vector of claim 14, wherein expression of said nucleic acid sequence of said vector results in production of at least one polyunsaturated fatty acid by said plant cell, plant or plant tissue.

- 20 18. The plant cell, plant or plant tissue of claim 17, wherein said at least one polyunsaturated fatty acid is selected from the group consisting of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).

- 25 19. One or more plant oils or acids expressed by said plant cell, plant or plant tissue of claim 17.

20. A transgenic plant comprising said vector of
claim 14, wherein expression of said nucleic acid
30 sequence of said vector results in production of at least one polyunsaturated fatty acid in seeds of said transgenic plant.

21. A method for producing a polyunsaturated fatty

acid comprising the steps of:

- a) isolating a nucleic acid sequence comprising
SEQ ID NO:8 or SEQ ID NO:9;
- 5 b) constructing a vector comprising said isolated
nucleic acid sequence operably linked to a
regulatory sequence;
- c) introducing said vector into a host cell for a
time and under conditions sufficient for
expression of polyketide synthase enzymes
10 encoded by said isolated nucleic sequence;
- d) exposing said polyketide synthase enzymes to a
substrate to produce a product; and
- e) exposing said product to at least one enzyme
selected from the group consisting of a
15 ketosynthase, a ketoreductase, a dehydratase,
an isomerase, an enoyl reductase, a desaturase,
and an elongase in order to produce said
polyunsaturated fatty acid.

20 22. The method of claim 21, wherein said substrate
is selected from the group consisting of acetyl-CoA
malonyl-CoA, malonyl-ACP, methylmalonyl-CoA and
methylmalonyl-ACP.

25 23. The method of claim 21, wherein said
polyunsaturated fatty acid is selected from the group
consisting of EPA and DHA.

30 24. A composition comprising at least one
polyunsaturated fatty acid produced according to the
method of claim 21.

25. The composition of claim 24 wherein said at

least one polyunsaturated fatty acid is selected from the group consisting of EPA and DHA.

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